IGS 92-20
REMOVE COMBUSTION GAS REHEAT

PHOTOGRAPHS FROM MODEL DEMONSTRATION TEST # 1

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NOVEMBER 23, 1993

ROUTING - REQUEST

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To JERRY HINTZE,
THIS COPY IS FOR
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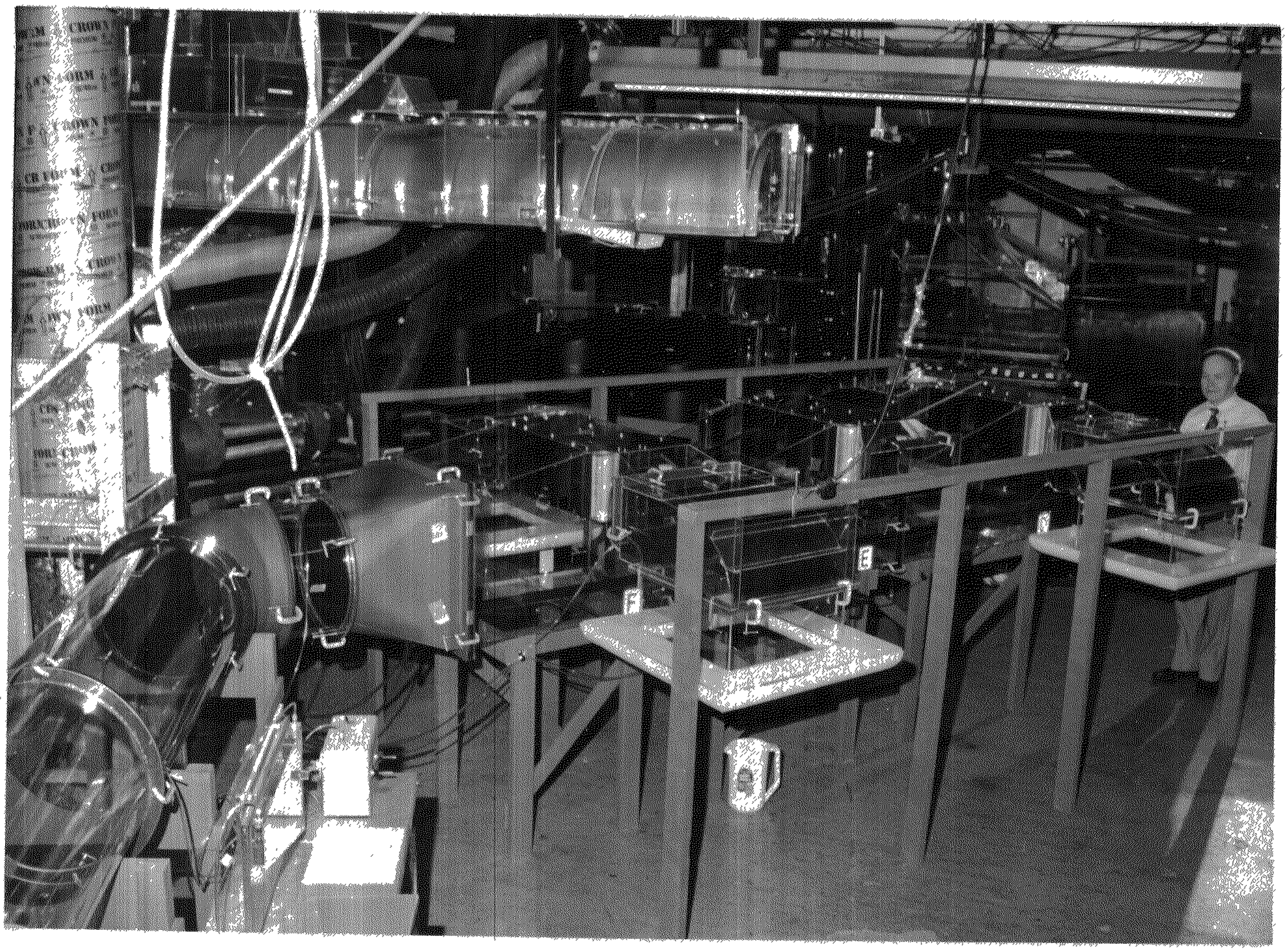
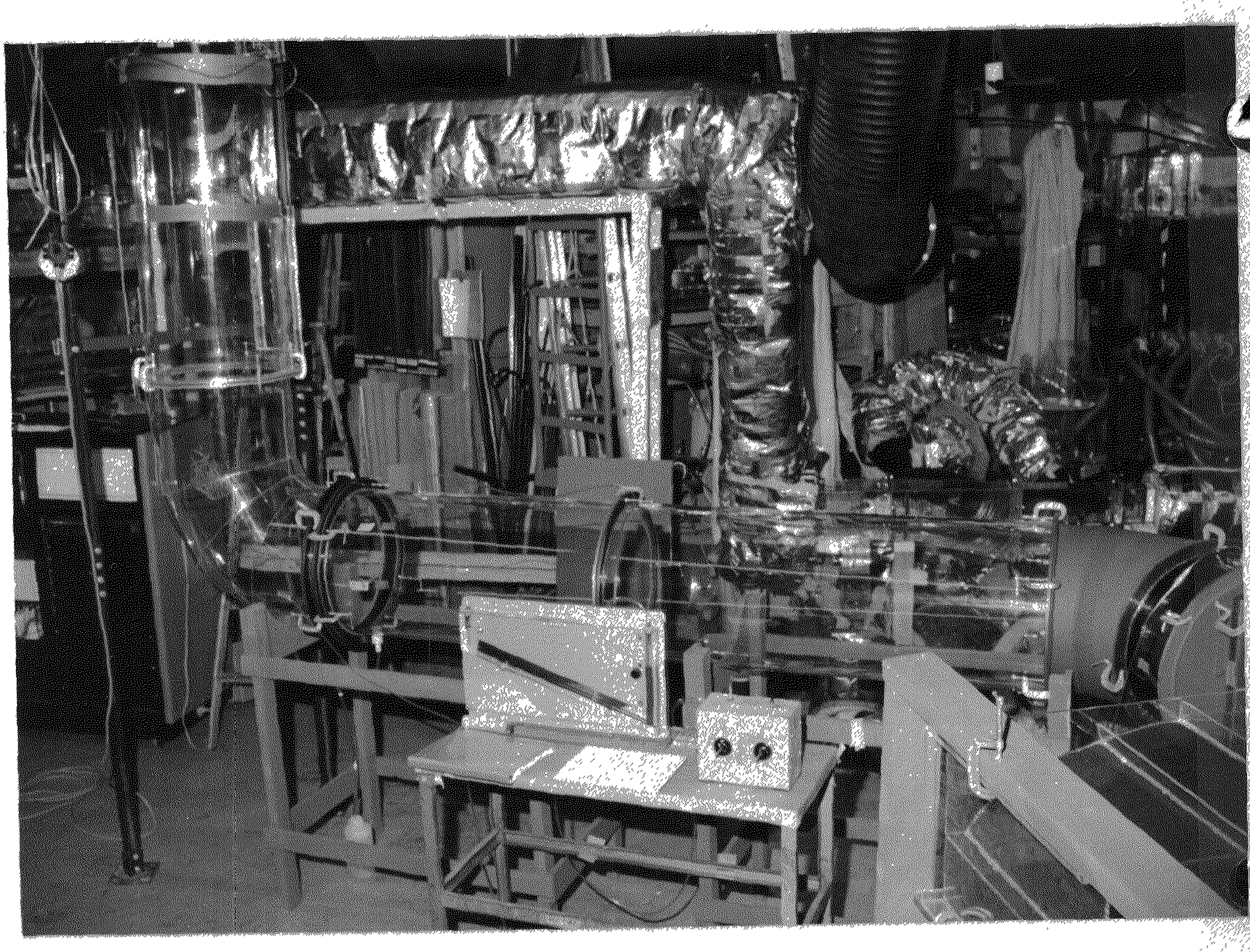
Date 12/20 From D. CLARK

MODEL CONSTRUCTED BY:
DYNAGEN,INC. UNDER CONSULTING AGREEMENT NO. 330



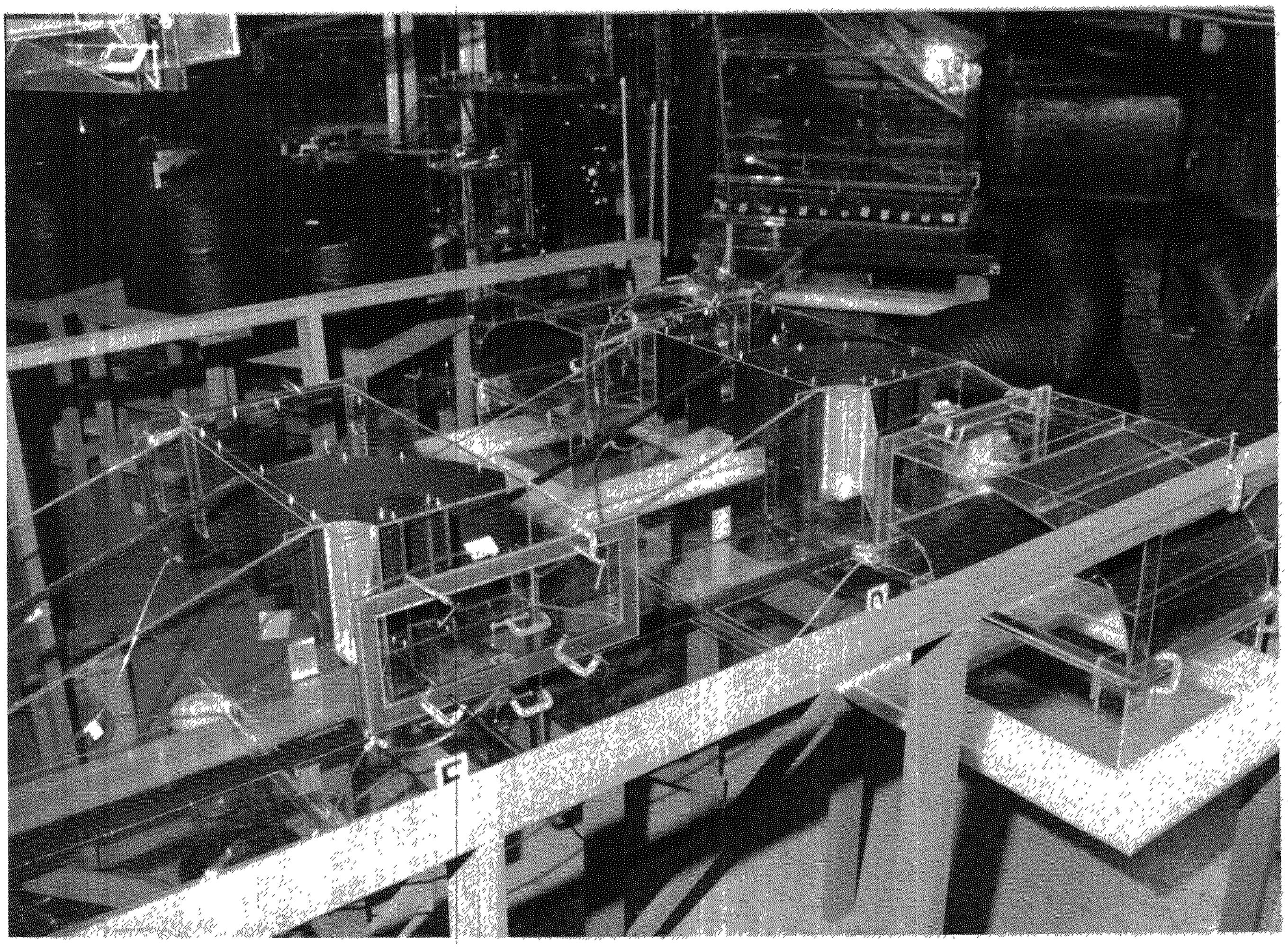
PHOTOGRAPH #1

Viewing the scale Plexiglas model of the Intermountain Generating Station Unit 1 absorber outlet duct and stack system from a position adjacent to the stack. This 1/19th scale model was constructed by DynaGen in their Cambridge facility. The 19.2 scale factor was chosen on account of the availability of 17.5" diameter Plexiglas tubing. The scrubber portion is approximately 8 feet wide by 10 feet long. Four absorber outlet sections (the top of the absorber with the vertical turning vanes) were constructed. The model is currently configure for flow through A, C, D, and F modules. The absorber outlet sections may be configured for flow through any combination of modules. The model includes the main internal structural members and turning vanes.



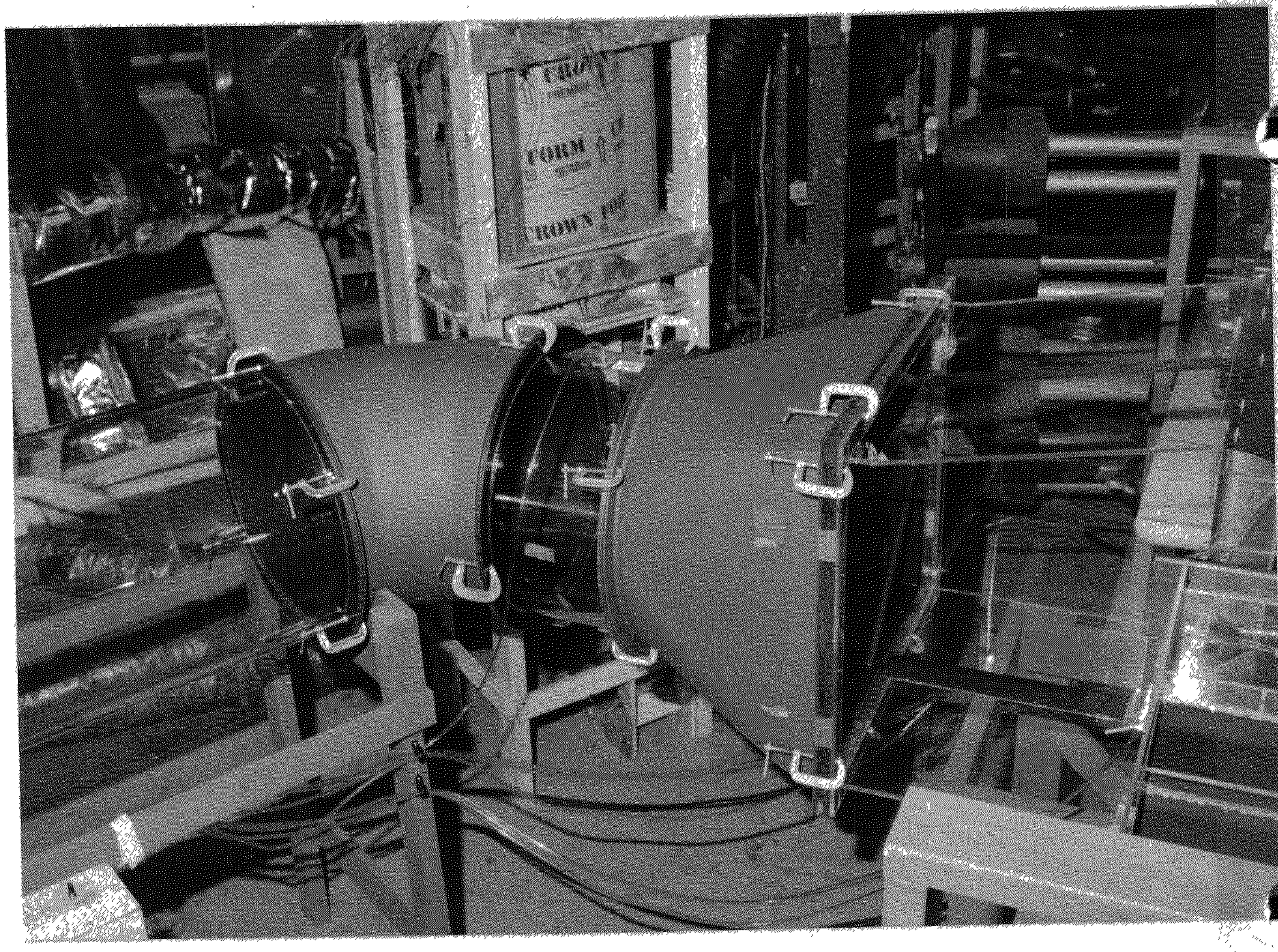
PHOTOGRAPH #2

Viewing the scale Plexiglas model from the absorber area towards the stack. The stack portion was fabricated up to a level corresponding to three diameters above the mitered elbow. By this point, the gas stream is fully developed. The condensation and re-entrainment occurring beyond this point is evaluated analytically.



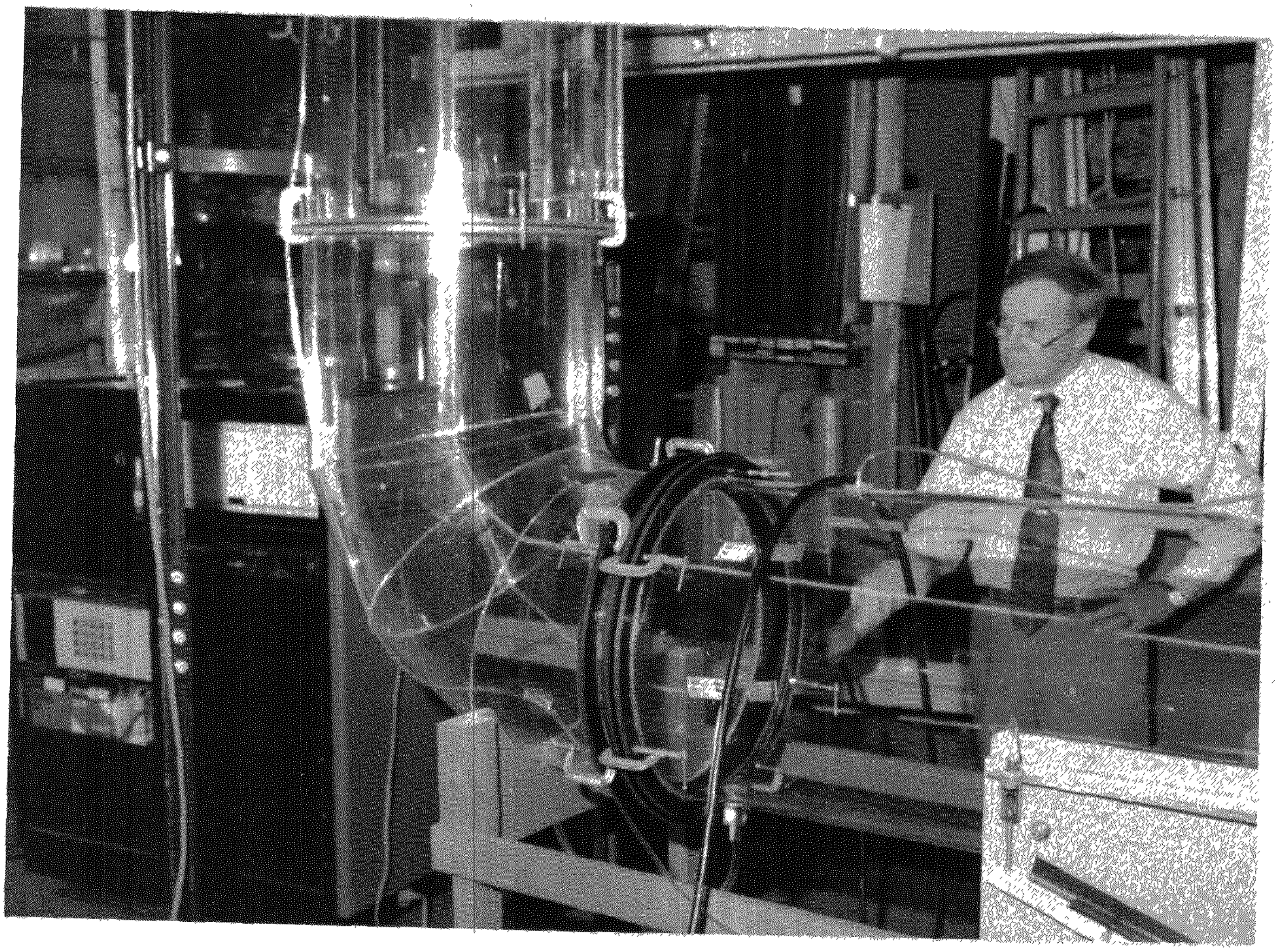
PHOTOGRAPH #3

A close up view of the D and E absorber outlets. The Absorber outlet section at module D is visible at the right of the photograph. The horizontal turning vanes from the absorber outlet section are clearly shown at modules D and E. These turning vanes will serve as one of the primary liquid collection areas.



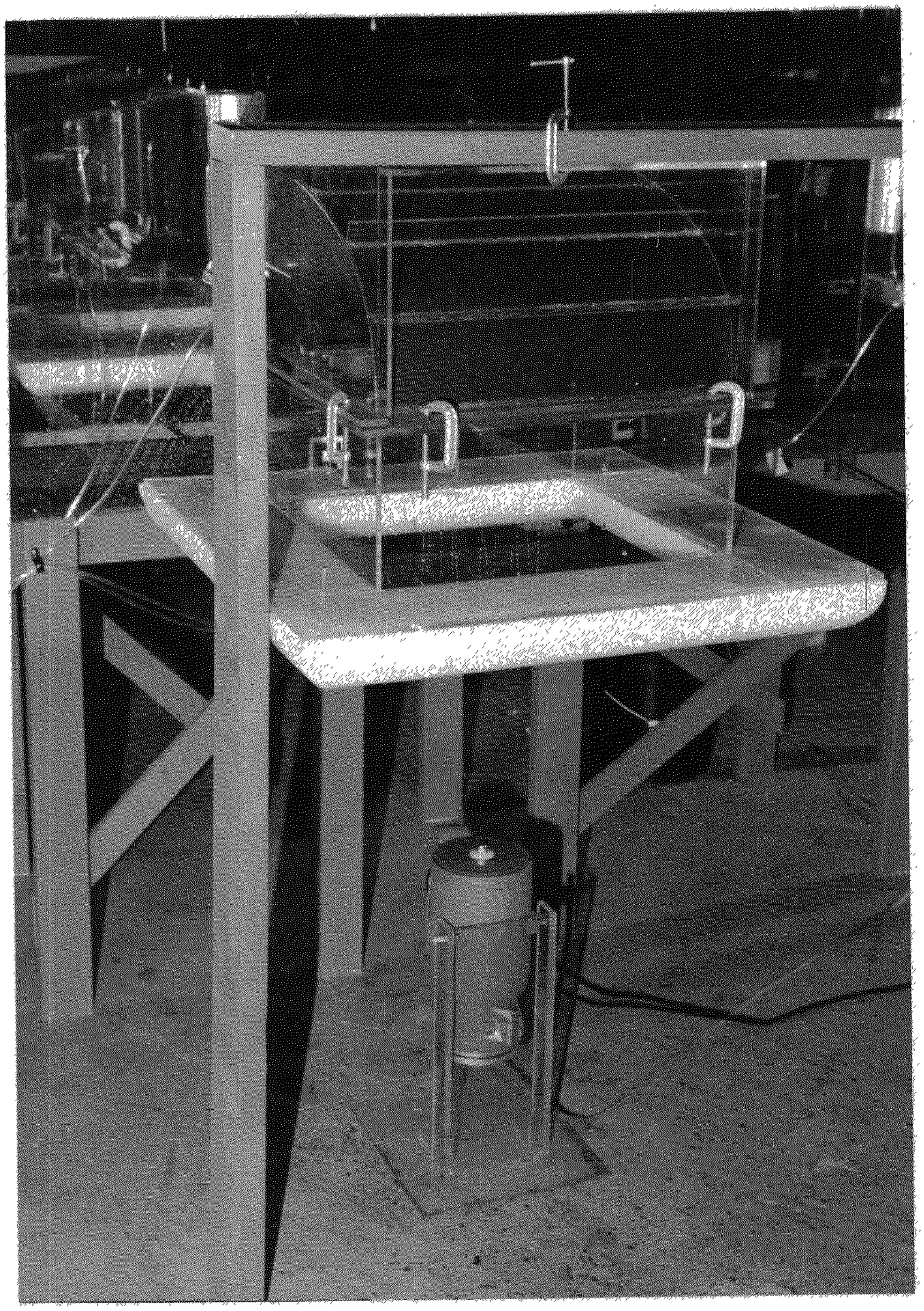
PHOTOGRAPH #4

A close up of the scrubber outlet main duct, the transition from rectangular to round ducting, and the 45° horizontal elbow. The transition piece and mitered elbow were fabricated of steel. One of the transition section's structural members is visible in the lower right corner of the rectangular section.



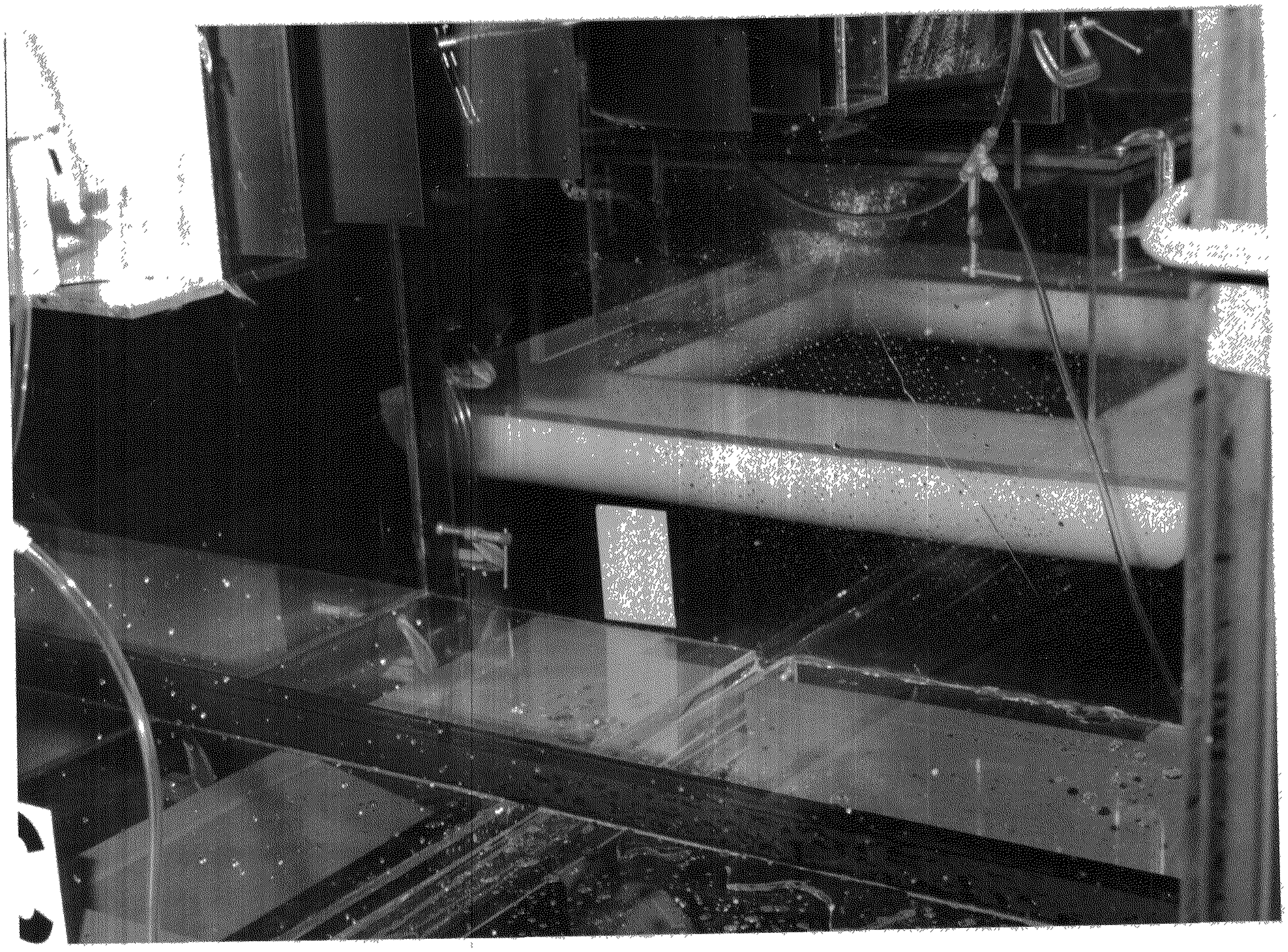
PHOTOGRAPH #5

A close up of the vertical elbow with Mr. Maroti (Technical director of DynaGen) introducing a smoke stream to observe flow through the mitered elbow. Mr. Maroti used the smoke stream to indicate an area of downward flow at the inner diameter at the top of the elbow. This causes liquid to flow down to the mitered edge of the elbow where it becomes re-entrained into the gas stream and leads to the fallout of large droplets. The black ring prior to the elbow is the expansion joint.



PHOTOGRAPH #6

Absorber Module F outlet with the mist generator below. Air flow is induced through the model by a fan and ducting connected to the top of the stack. The mist generator introduces small droplets into the induced gas stream. Some droplets are visible adhering to the walls of the module and main outlet duct.

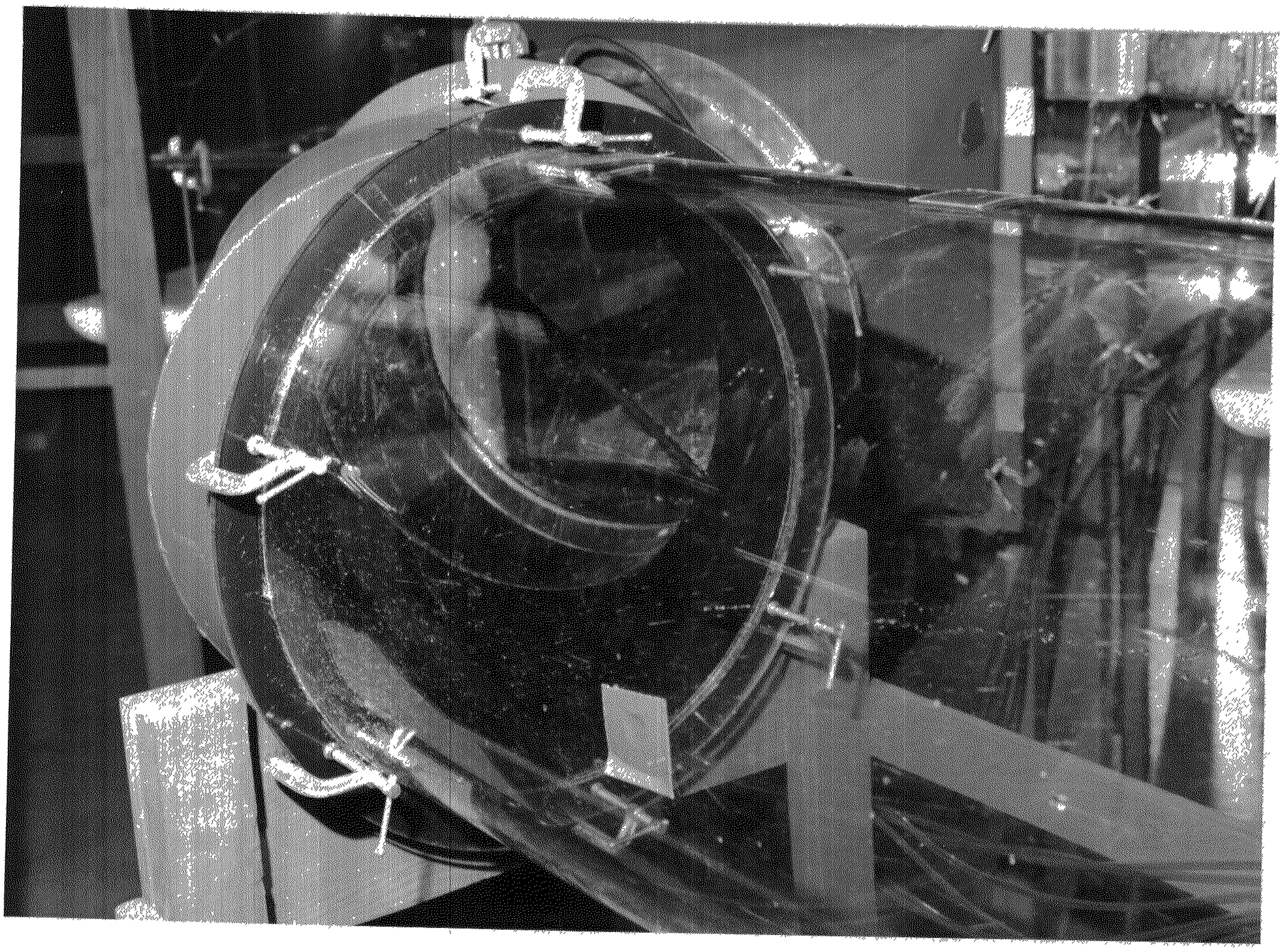


PHOTOGRAPH #7

A view of the trailing edge of the turning vanes for absorber outlet C and F within the main outlet duct. The mist generator is presently located beneath the F absorber module. Since there is no floor in the turning vane area, the gas flows down and out from the vanes. The largest droplets flow down the vanes at approximately a 45 degree angle and fall to the floor. Some of these are carried by the gas stream towards the transition piece. Additional droplets follow the turning vanes to the trailing edge where they are re-entrained into the gas flow. See the following picture.

PHOTOGRAPH #8

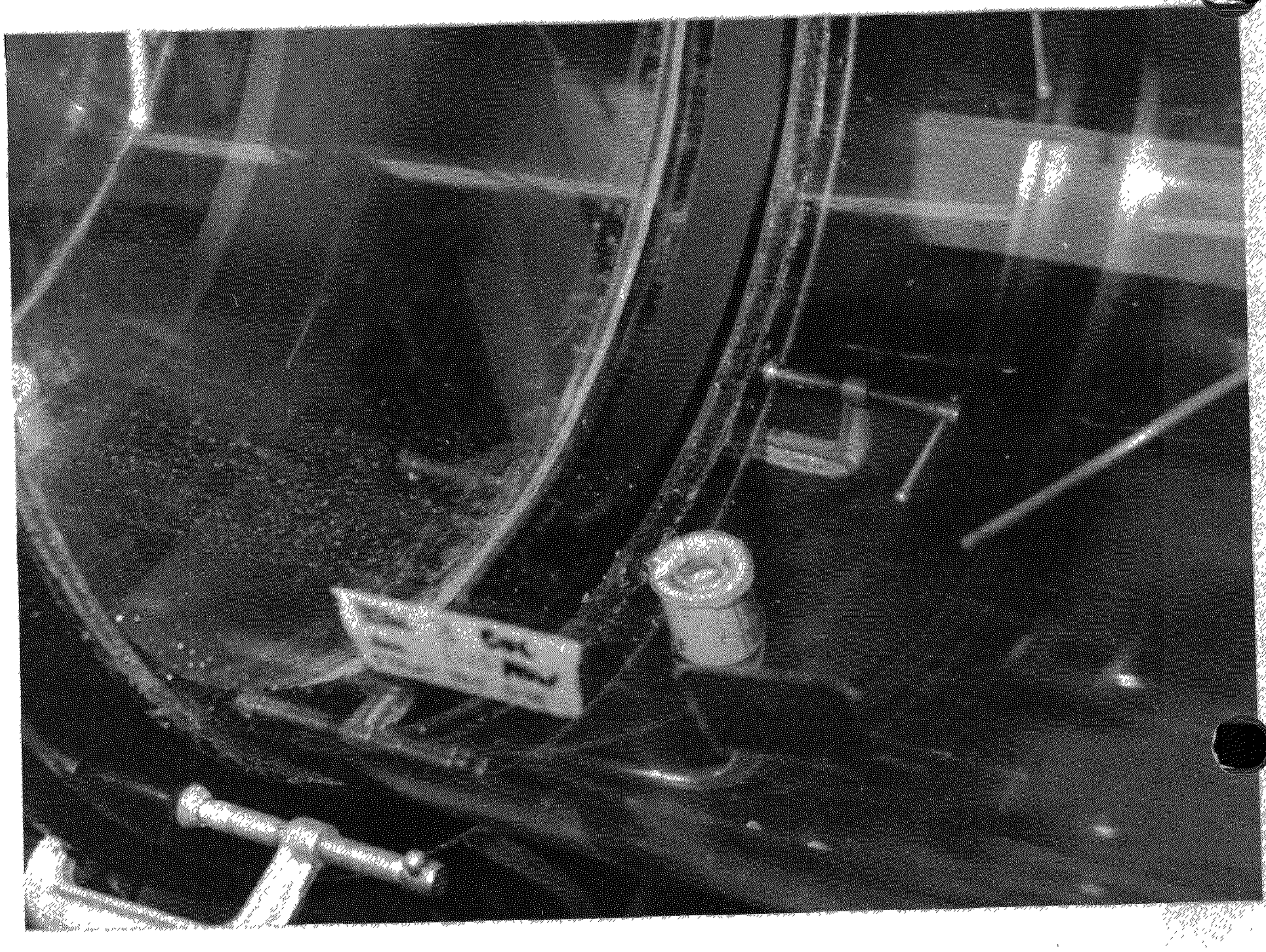
A close up of the F module turning vanes with the mist generator in service. The stream of droplets visible on the main outlet duct wall indicate the general flow path. A large droplet is visible at the bottom corner of the middle turning vane. Droplets like this can be re-entrained in the gas flow from modules C and F and possibly from B and E. This will not occur at modules A and D because of the significantly lower gas flow at those locations. To reduce fallout, the turning vanes may be modified to collect and drain the water that impinges on the concave sides of the vanes. DynaGen has suggested extending the vanes, with the trailing edge slanted downward at a 45° angle, and incorporating a structural along the trailing edge to catch the droplets and direct them down to the bottom of the vane. A floor would be added to the vane area with a structural angle at the outlet edge to direct the droplet flow to the outlet duct walls.



PHOTOGRAPH #9

The 45° horizontal elbow from the downstream side looking towards the transition region. A swirl of the gas flow induced by the mitered bend acts to keep impinging droplets from draining down the horizontal run of ducting towards the floor where they can be drained. Instead, this liquid tends to remain at the same elevation along the entire run all the way to the vertical elbow where it currently may be re-entrained into the gas flow. The pieces of duct tape noticeable in the picture cover holes that may be used to introduce smoke or liquid to study local effects.

To promote further deposition of liquid and to reduce the swirling effect of the 45° bend, DynaGen has suggested the use of turning vanes at this location. The vanes would have a sloping trailing edge similar to the absorber outlet vanes to direct liquid flow to the floor.



PHOTOGRAPH #10

Here is a view of the expansion joint and drain located prior to the vertical elbow. The liquid stream indicates just a portion of the liquid drains out of the duct and the remainder travels over the joint. About half of the liquid flowing over the joint is re-entrained into the gas flow at the trailing edge of the joint. A collection ring facing upstream into the gas flow could prevent this liquid loss.

PHOTOGRAPH #11

The mitered vertical elbow viewed from the downstream side looking towards the horizontal bend. The liquid impinging on the outer diameter of the elbow flows up and to each side. Although not visible in this picture, a large amount of the liquid loops around all the way to the inner diameter and then drains down to the mitered edges of the elbow. See the following picture for a side view.

PHOTOGRAPH #12

A side view of the mitered elbow with liquid being introduced above the mitered cuts. The liquid traveled down to the mitered elbow and would drip off the sharp edge and be swept into the high velocity gas stream where to be carried up out of the stack. DynaGen has suggested two ways of modifying this region to reduce fallout. One would be to replace the elbow with a large diameter section that would permit draining on the outside wall due to lower gas velocities. This may be cost prohibitive. A second alternative is to jacket the existing elbow and cut slots through the liner. This would permit the draining of water within the jacketed area that is shielded from high gas flow.